Optic Ataxia

McIntosh RD (in press).
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Optic ataxia

In normal adults, even the most mundane interactions with the objects around us are virtuoso feats of elegance and efficiency. Much of this elegance derives from the effortless use of vision to anticipate the properties of objects, and to monitor the progress of ongoing movements. In reaching for a glass of water, for instance, visual localisation helps you direct your hand to the glass, and visual analyses of its size and shape guide your hand to enclose it. Vision may also prompt you to veer around other objects, or to correct your movement for errors or for changes in the position of the glass or obstacles. Optic ataxia describes a condition in which some or all of these abilities are lost following damage to the parts of the brain linking vision to action. It is characterised broadly by an inaccuracy of visually-guided movement, which is not due to more general visual or motor impairments. In reaching for a seen object, a person with severe optic ataxia may seem to grope in the dark, extending a flattened hand hesitantly until a chance contact allows the object to be retrieved by touch.

History

The term "optic ataxia" ("optische Ataxie" in the original German), was coined by the Hungarian physician Rudolf Bálint in his 1909 report of a man with lesions of the posterior parietal lobe on both sides of the brain. Optic ataxia was one of a cluster of symptoms, now known collectively as Bálint's syndrome, which included the restriction of visual attention to single objects, and a paucity of spontaneous eye movements. Bálint noted inaccurate reaching of the right hand, and the patient himself commented that this hand was clumsy. For instance, he often found himself lighting a cigarette at its middle instead of at its end. These errors could not be ascribed to any general visual impairment, as his left-hand reaching was accurate. Similarly, he could make coordinated right-hand reaches, with eyes closed, to different parts of his body, ruling out a right-sided movement disorder. The problem was thus neither visual nor motor, but *visuomotor*, emerging only for movements made under visual guidance. This confluence is well captured by Bálint's coinage, which implies a movement disorder (ataxia) that is specifically visual (optic).

Presentation and diagnosis

When optic ataxia is severe, misreaching will be obvious to the patient and to others. However, specialised testing may be required to confirm the symptom, or to diagnose its subtle forms. Typically, the examiner will present an object, such as a pen, to the left or the right side for grasping by each hand. This will be done both when the patient can look at the pen directly, and when they must look straight ahead so that it falls outside of central vision. Misreaching most often emerges only in the latter case, with accurate reaches under direct viewing. It may also be specific to certain combinations of target side and hand. Two main patterns can be expected: a 'field effect', whereby large errors are made, with either hand, on the side of space opposite the responsible brain damage, and/or a 'hand effect', whereby the hand anatomically opposite to the brain damage misreaches for targets on either side. To confirm the diagnosis, it should be shown that the errors are not due to other disorders affecting vision or movement.

Additional features
The *sine qua non* of optic ataxia is inaccurate reaching to visual targets, but a range of related impairments may be present, including failure to rotate or pre-shape the hand appropriately for grasping, inability to correct ongoing movements for changes in target position, and insensitivity to obstacles in the reach space. Inaccurate visuomotor guidance may also be observed for the foot, by asking the patient to touch a target with the toe. No systematic study has investigated whether these sub-symptoms require damage to different brain areas. For misreaching, at least, the pattern of errors may depend on the side of the brain damage. Perenin and Vighetto noted that damage to the right side of the brain tended to provoke a field effect, whilst an additional hand effect was often present after left-brain damage. However, since the number of patients studied was small, the generality of these patterns awaits confirmation. The typical spatial character of the errors is also uncertain: several investigators have found that, for peripheral targets, optic ataxic misreaching tends to be markedly towards central vision, though not all patients have been found to show this pattern.

Neuroanatomy
Patients with optic ataxia may have extensive brain damage, especially if the symptom manifests as part of Bálint's syndrome. Bálint's original patient, for instance, had lesions to the posterior parietal lobe, extending into the occipital lobe, on both sides of the brain. However, lesions restricted to one side of the brain are the more usual cause of isolated optic ataxia. By studying patterns across patients, it may be possible to discern whether there is any specific sub-region that is invariably affected. The key areas of involvement have usually been taken to be the intraparietal sulcus and adjacent parts of the superior parietal lobe. However, the latest and largest lesion analysis has suggested that misreaching for peripheral targets may more often follow damage close to the junction between the occipital and parietal lobes. These brain areas are presumably critical for the visual guidance of reaching in humans.

Robert D. McIntosh
University of Edinburgh, UK.

Cross-references
Action and vision; Bálint's syndrome; eye and limb tracking; parallel pathways in sensory systems; reaching and grasping; visual disorders.

Further readings
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